(British Standards Association
Report
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No. 14—1907.

British Engineering Standards Association.

(*Incorporated 1918.*)

Formed in 1901 as The Engineering Standards Committee

by

The Institution of Civil Engineers.
The Institution of Mechanical Engineers.
The Institution of Naval Architects.
The Iron and Steel Institute.
The Institution of Electrical Engineers.

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BRITISH STANDARD SPECIFICATION FOR STRUCTURAL STEEL FOR MARINE BOILERS.

(REVISED, MARCH, 1907.)

LONDON:
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No. 14—1907.

British Engineering Standards Association.

(Incorporated 1918.)

FORMED IN 1901 AS THE ENGINEERING STANDARDS COMMITTEE

BY

THE INSTITUTION OF CIVIL ENGINEERS.
THE INSTITUTION OF MECHANICAL ENGINEERS.
THE INSTITUTION OF NAVAL ARCHITECTS.
THE IRON AND STEEL INSTITUTE.
THE INSTITUTION OF ELECTRICAL ENGINEERS.

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No. 14—1907.

BRITISH ENGINEERING STANDARDS ASSOCIATION.

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† Succeeded the late SIR JOHN WOLFE BARRY, K.C.B., February, 1918.

BRITISH ENGINEERING STANDARDS ASSOCIATION.

The following is a list of Members of the Sectional Committee on Sections and Tests for Materials used in the construction of Ships and their Machinery who have had the revision of this Specification under consideration.

◆

SECTIONAL COMMITTEE ON SECTIONS AND TESTS FOR MATERIALS USED IN THE CONSTRUCTION OF SHIPS AND THEIR MACHINERY.

March, 1907.

Chairman, MR. ARCHIBALD DENNY.

Admiralty, *Sir John Durston, K.C.B., R.N.; Mr. R. J. Butler, C.B.; Mr. W. E. Smith, C.B.

Board of Trade, *Mr. P. Samson.

Institution of Naval Architects, *Mr. James Dunn; Mr. W. J. Pratten.

Iron and Steel Institute, Mr. Arthur Cooper.

Institution of Engineers and Shipbuilders in Scotland, Mr. Alex. M. Kennedy; Mr. Alexander Gracie.

North-East Coast Institution of Engineers and Shipbuilders, Mr. Henry Withy; Mr. Summers Hunter.

Steel Ingot Makers' Association, *Mr. David Colville; *Mr. F. W. Dick.

English and Scottish Forge Masters' Association, Mr. A. D. Wedgwood.

Steel Forging Makers' Association
English and Scottish Steel Founders' Association } Mr. Bernard A. Firth.

Lloyd's Register of British and Foreign Shipping, Mr. H. J. Cornish; Mr. J. T. Milton.

British Corporation for the Survey and Registry of Shipping, Mr. J. Foster King.

Bureau Veritas, Mr. John Gravell.

South Staffordshire Ironmasters' Association, Sir George Hingley, Bart.

North of England Iron and Steel Manufacturers' Association, *Mr. William Thackray.

Scottish Iron Manufacturers' Association, Mr. William Wylie.

*Mr. J. Hamilton Turner, Mr. James McKechnie, Prof. W. C. Unwin.

---

* Since deceased.

PREFACE.

The Committee on Ships Sections was appointed by the Main Committee on July 19th, 1901.

Having, in conjunction with the Committee on Bridges, and the Committee on Railway Rolling Stock Underframes, completed the Standard Lists of Rolled Sections for Structural Purposes, the Committee next dealt with Standard Specifications for Steel and Iron Material used in Shipbuilding. For this purpose the Committee was considerably enlarged and, under the title of the Sub-Committee on Tests for Steel and Iron Material used in the Construction of Ships and their Machinery, has held nine meetings.

A small Sub-Committee consisting of the representatives of the Admiralty, the Board of Trade, and the three Registry Societies was appointed by the Sub-Committee on Tests for Steel and Iron Material used in the Construction of Ships and their Machinery on October 2nd, 1903, to draw up a draft Specification for Steel for Marine Boilers. The present Specifications of the Admiralty, the Board of Trade, and the three leading Registry Societies were carefully compared, and from these a draft Specification was prepared, which was submitted to the Sub-Committee on Tests for Steel and Iron Material used in the Construction of Ships and their Machinery, at their meeting held on November 18th, 1904, and adopted by them.

This Report was approved by the Main Committee at their meeting on December 8th, 1904.

A. DENNY,

Chairman of the Sectional Committee on Sections used in Shipbuilding.

First Revision: The Specification in its present form was approved by the Main Committee at their Meeting on March 7th, 1907.

NOTE.—*The Association desires to call attention to the fact that this Specification is intended to include the technical provisions necessary for the supply of the material herein referred to, but does not purport to include all the necessary provisions of a Contract.*

BRITISH
STANDARD SPECIFICATION
FOR
STRUCTURAL STEEL FOR MARINE BOILERS.

(REVISED, MARCH, 1907.)

Process of Manufacture.

1. Structural steel for Marine Boilers shall be made by the Open Hearth process, acid or basic, as may be specified, and as approved by the Inspecting body.

Freedom from Defects.

2. The finished material shall be free from cracks, surface flaws, and lamination. It shall also have a workmanlike finish, and must not have been hammer-dressed, but this does not prevent removal of slight scale or shell by the use of chisel, file, or buff.

Testing and Inspection.

3. The following tests and inspections shall be made at the place of manufacture prior to despatch; but, in the event of any of the material proving unsatisfactory in the course of being worked into boilers, such material shall be rejected, notwithstanding any previous certificate of satisfactory testing, and such further tests of the material from the same charge may be made as the Inspector in attendance may consider desirable.

Tensile Test Pieces.

4. The Tensile strength and ductility shall be determined from Standard test pieces cut lengthwise or crosswise from the rolled material. When material is annealed or otherwise treated before despatch, the test pieces shall be similarly and simultaneously treated with the material before testing.

Plates:—Wherever practicable the rolled surfaces shall be retained on two opposite sides of the test piece. The elongation shall be measured on a Standard test piece having a gauge length of 8 inches.

For material more than 0·875 in. in thickness the width of the test piece between the gauge points shall not exceed $1\frac{1}{2}$ ins.; for material 0·875 in. to 0·375 in. in thickness, inclusive, the width shall not exceed 2 ins.; for material less than 0·375 in. in thickness the width shall not be more than $2\frac{1}{2}$ ins. In other respects the test pieces shall conform generally to the Standard Test Piece **A** (*see* Appendix containing the forms of British Standard Tensile Test Pieces, page 14).

Round Bars :—Bars may be tested full size as rolled, or they may be turned down to a convenient size, and if tested one inch in diameter or under the test piece shall have a gauge length of not less than 8 times the diameter. When enlarged ends are used the length of the parallel portion shall be not less than 9 times the reduced diameter (*see* Standard Test Piece **B,** page 15). The sectional area of the test piece shall be not less than $\frac{1}{4}$ square inch. Where bars are above 1 inch diameter, and are tested full size as rolled, or have been turned down and the resulting test piece is above 1 inch diameter, a gauge length of 4 times the diameter may be used if preferred by the Manufacturer, in which case an increased elongation will be required, as specified in Clause 6. When enlarged ends are used the length of the parallel portion shall be not less than $4\frac{1}{2}$ times the reduced diameter (*see* Standard Test Piece **F,** page 16).

Any straightening of test pieces which may be required shall be done cold.

Mechanical Tests and Selection of Test Pieces.

5. Plates and bars for boilers shall comply with the following mechanical tests. All test pieces shall be selected by the Inspector and tested in his presence, and he shall satisfy himself that the conditions herein described are fulfilled.

Tensile Tests.

6. Plates :—The tensile breaking strength of steel plates for shells and girders, determined from Standard test pieces, shall be between the limits of 28 and 32 tons per square inch. For plates intended for flanging or welding, and for combustion chambers and furnaces, the tensile breaking strength shall be between the limits of 26 and 30 tons per square inch. In the case of material for purposes in which tensile strength is not important, the tensile test may be dispensed with and the bend test only made, if so specified and approved. The elongation, measured on a Standard test piece having a gauge length of 8 ins., shall be not less than 20 per cent. for material of 0·375 in. in thickness and upwards required to have a tensile breaking strength of 28 to 32 tons per square inch; and not less than 23 per cent. for material of 0·375 in. in thickness and upwards required to have a tensile breaking strength of 26 to 30 tons per square inch.

Stay, Angle and Tee Bars:—The tensile breaking strength of longitudinal stays and angle and tee bars shall be between the limits of 28 and 32 tons per square inch, with an elongation of not less than 20 per cent. measured on the Standard test piece. For bars for combustion chamber stays the tensile breaking strength shall be between 26 and 30 tons per square inch, with an elongation of not less than 23 per cent. measured on the Standard test piece.

For material under 0·375 in. in thickness the elongation may be not more than 3 per cent. below the above-named elongations.

Where Stay Bars are tested on a gauge length of 4 times the diameter (Test Piece **F,** page 16) the elongation shall be 24 per cent. instead of 20 per cent., and 28 per cent. instead of 23 per cent.

Rivet Bars:—The tensile breaking strength of rivet bars shall be between the limits of 26 and 30 tons per square inch of section, with an elongation of not less than 25 per cent. measured on the Standard Test Piece **B** or 30 per cent. measured on the Standard Test Piece **F** (*see* Appendix, pages 15 and 16). The bars may be tested the full size as rolled.

Number of Tensile Tests.

7. Plates:—One tensile test shall be taken from each plate as rolled. For plates exceeding $2\frac{1}{2}$ tons in weight one tensile test shall be taken from each end.

Angle, Rivet and Stay Bars:—At least two tensile tests for angle bars, rivet bars, and stay bars shall be taken from each charge; but when the number of the bars, as rolled, from one charge exceeds 15, an additional tensile test shall be made for each further batch of 15 bars or portion thereof. In round bars of $1\frac{3}{4}$ inches diameter and under the number shall be 50 in place of 15.

Should a tensile test piece break outside the middle half of its gauge length, the test may, at the Maker's option, be discarded and another test be made of the same plate or bar.

Bend Tests.

8. Cold Bends :—Test pieces shall be sheared lengthwise or crosswise from plates or bars, and shall be not less than 1½ ins. wide, but for small bars the whole section may be used. For rivet bars bend tests are not required.

Temper Bends :—The test pieces shall be similar to those used for cold bend tests. For temper bend tests the samples shall be heated to a blood red and quenched in water at a temperature not exceeding 80° Fahr. The colour shall be judged indoors in the shade.

In all cold bend tests, and in temper bend tests on samples 0·5 in. in thickness and above, the rough edge or arris caused by shearing may be removed by filing or grinding, and samples 1 in. in thickness and above may have the edges machined, but the test pieces shall receive no other preparation. The test pieces shall not be annealed unless the material from which they are cut is similarly annealed, in which case the test pieces shall be similarly and simultaneously treated with the material before testing.

For both cold and temper bends the test piece shall withstand, without fracture, being doubled over until the internal radius is equal to 1½ times the thickness of the test piece, and the sides are parallel.

For small sectional material these bend tests may be made from the flattened bar.

Bend tests may be made either by pressure or by blows.

Number of Bend Tests.

9. Plates :—One cold or temper bend test shall be taken from each plate as rolled. For plates exceeding 2½ tons in weight one bend test shall be taken from each end—one bend test to be temper and the other cold.

Angle bars :—A cold or a temper bend test shall be made from each angle bar rolled.

Stay bars :—A cold and temper bend test shall be made from every 15 stay bars as rolled from each charge.

Tests for Manufactured Rivets.

10. Rivets selected by the Inspector from the bulk, in such proportion as may be specified and approved, shall withstand the following tests :—

(*a*) The rivet shanks to be bent cold, and hammered until the two parts of the shank touch in the manner shown in Fig. 1, without fracture on the outside of the bend.

(*b*) The rivet heads to be flattened, while hot, in the manner shown in Fig. 2, without cracking at the edges. The head to be flattened until its diameter is $2\frac{1}{2}$ times the diameter of the shank.

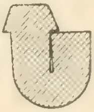


FIG. 1.

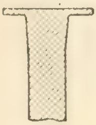


FIG. 2.

Additional Tests before Rejection.

11. Should the test pieces first selected by the Inspector not fulfil the test requirements, two further tests may be made, but should either of these fail, the plates or bars from which the test pieces were cut shall be rejected. In all such cases further tests shall be made before any material from the same charge can be accepted.

Branding.

12. Every plate and bar manufactured to this Specification shall be clearly and distinctly marked by the Maker in two places with an approved quality brand indicating that the material has complied with the Standard tests.

No plates or bars bearing this brand shall be forwarded from the Steel Works until the prescribed tests have been made by the Inspector, and the mill sheet signed by him. All plates and bars shall also be legibly marked in two places with the Maker's name or trade mark, the place where made, and with number or identification marks by which they can be traced to the charge from which the material was made.

Maker's Certificate.

13. Before the mill sheets are signed, the Maker shall furnish the Inspector with a certificate guaranteeing that the material has been made by the Open Hearth process, as specified and approved, and that it has been subjected to, and has withstood satisfactorily, the tests above described in the presence of the Inspector. The following form of certificate will be accepted if printed on each mill sheet with the name of the firm, and initialled by the Test House Manager:—

> "We hereby certify that the material described below has been made by the Open Hearth process, as specified and approved, and is that which has been satisfactorily tested in the presence of your Inspector in accordance with the Standard tests."

Defacing of Rejected Material.

14. In the event of the material failing, in any case, to withstand the prescribed tests, the Inspector shall see that the quality brand stamped on the plates and bars by the Maker has been defaced by punch marks extending beyond the brand in the form of a cross, denoting that the material has been rejected.

Facilities for Inspection.

15. The Maker shall adopt a system of marking the ingots, billets, slabs, plates, bars, &c., which will enable all finished material to be traced to the original charge, and the Inspector must be given every facility for tracing all plates and bars to their respective charges, and for witnessing the required tests. When he is satisfied with the material and with the results of the tests, he shall be furnished with two copies of the advice notes of the material for his signature.

Steel not produced where Rolled.

16. Where steel is not produced in the works at which it is rolled, a certificate shall be supplied to the Inspector deputed to witness the testing of the material, stating the Open Hearth process by which it was made, the name of the Steel Maker who supplied it, also the numbers of the charges for reference to the books of the Steel Maker. The number of the charge shall be marked on each plate or bar for the purpose of identification.

APPENDIX.

FORMS

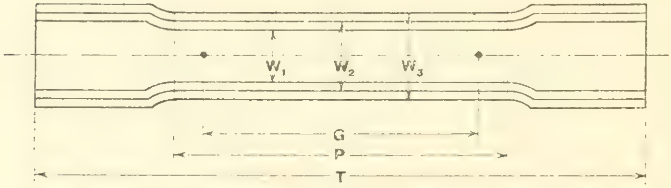
OF

BRITISH STANDARD TENSILE TEST PIECES.

APPENDIX.

FORMS
OF
BRITISH STANDARD TENSILE TEST PIECES.

TEST PIECE **A.**

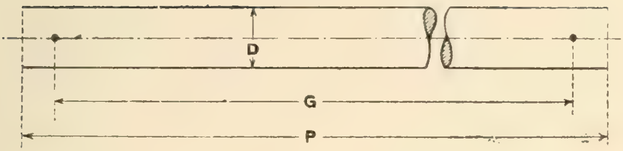


Gauge Length **G** = 8 inches.
Parallel Length **P** to be not less than 9 inches.
Total Length **T** = About 18 inches.

Thickness of Test Piece.	Maximum Width allowed.
Over $\frac{7}{8}$ in. (0·875 in.).	**W_1** = $1\frac{1}{2}$ ins.
$\frac{3}{8}$ in. (0·375 in.) to $\frac{7}{8}$ in. (0·875 in.).	**W_2** = 2 ins.
Under $\frac{3}{8}$ in. (0·375 in.).	**W_3** = $2\frac{1}{2}$ ins.

The widths of the test pieces for plates were selected to comply with the two following conditions. (1) As the great bulk of plates to be tested are from $\frac{3}{8}$ inch to $\frac{7}{8}$ inch thick, it was desirable for the sake of convenience that the test pieces for such plates should be of uniform width, and, in accordance with very general practice, a width of 2 inches was selected. (2) With a test piece of a given form, the percentage of elongation was found to be less for thick plates than for thin ones; with steel of the same quality in other respects it was desirable therefore to choose widths of test piece which would be slightly in favour of the thicker plates. This is secured with the widths selected for the Standard Test piece of form **A.**

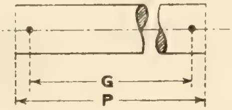
TEST PIECE **B.**



Gauge Length **G** to be not less than 8 times the diameter **D.**
With enlarged ends:—Parallel Length **P** to be not less
than 9 times the reduced diameter **D.**

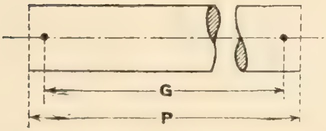
All test pieces of form **B** are strictly similar, and for the same material give the same percentage of elongation. They are nearly similar to a test piece of form **A,** 8 inches in gauge length, 2 inches wide and $\frac{3}{8}$ inch thick.

TEST PIECE **C.**



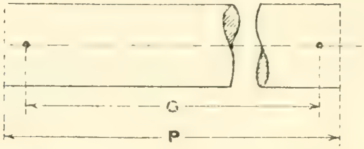
Gauge Length **G** = 2 inches.
Parallel Length **P** to be not less than $2\frac{1}{4}$ inches.
Dia. = 0·564 inch.
Area = $\frac{1}{4}$ sq. inch.

TEST PIECE **D.**



Gauge Length **G** = 3 inches.
Parallel Length **P** to be not less than $3\frac{3}{8}$ inches.
Dia. = 0·798 inch.
Area = $\frac{1}{2}$ sq. inch.

TEST PIECE **E.**

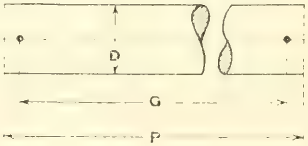


Gauge Length **G** = 3½ inches.
Parallel Length **P** to be not less than 4 inches.
Dia. = 0·977 inch.
Area = ¾ sq. inch.

Test Pieces **C, D** and **E** were arranged to meet the very common practice of making test pieces for forgings, axles, tyres, etc., of either ¼ square inch or ½ square inch in sectional area. With the gauge lengths decided upon, these three forms are very nearly similar, and, for a given material, give very approximately the same percentage of elongation. Though not exactly, they are approximately similar to the Standard Test Piece **F,** and for the same material give a nearly identical, but slightly greater, percentage of elongation.

TEST PIECE **F.**

(For Test Pieces over 1 inch diameter.)



Gauge Length **G** to be not less than 4 times the diameter **D**.
With enlarged ends :—Parallel Length **P** to be not less than 4½ times the reduced diameter **D**.

In some testing machines it was found inconvenient to use form **B** for bars of over 1 inch in diameter, and form **F** of half the gauge length is designed to meet such cases. For a given material the percentage of elongation with Test Piece **F** is greater than with Test Piece **B,** and this difference is provided for in the British Standard Specifications.

FORM OF ENDS.

In the case of the round test pieces **B, C, D, E** and **F,** the form of the ends is to be as required in order to suit the various methods employed for gripping the test piece. When enlarged ends are used the length of the parallel portion of the test piece must in no case be less than that noted on the diagrams.

British Engineering Standards Association.

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OF
BRITISH STANDARD SPECIFICATIONS AND REPORTS.

FEBRUARY, 1919.

(This List cancels all previous Lists.)

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